RING LASER GYROSCOPE WITH TILTING MIRRORS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to minimizing the effects of lock-in for an RLG and more particularly to dithering the optical path of the RLG by tilting the mirrors.

2. Description of the Prior Art

A ring laser gyro must overcome the problem of "lock-in" to be a practical device for measuring low rotation rates. One commaon method to minimize the effects of lock-in for an RLG is to mechanically dither the RLG. This is accomplished by using a flexure to sinusoidally rotate (dither) the RLG laser frame assembly with respect to its mounting plate. The sinusoidal motion has a large peak angular velocity but low angular displacement. The time that this input rate is below the lock-in threshold is thereby greatly reduced. The mechanical energy involved with dithering an RLG laser frame assembly presents problems when designing a system with three or more ring laser gyroscopes. Precautions must be made to avoid coupling of mechanical energy to other gyros or to the system.

One possible alternate approach is to dither the mirrors. Several patents (U.S. Pat. Nos. 4,686,683, 4,410,276, 4,410,274, 4,653,919 and 4,592,656) describe the use of mirror actuators that translate the mirror in a linear motion however none of these patents describe the improved performance technique of dithering the mirrors in an angular motion.

SUMMARY OF THE INVENTION

The present invention does not employ the dithering of the RLG mirror(s) in a linear motion as described in the prior art but rather the dithering of the mirrors in an angular motion. The optical path for a resonant RLG is defined by the location and angles of the mirrors. By sinusoidally tilting the mirrors, the optical path can be sinusoidally rotated (dithered), thereby imparting the desired sinusoidal angular rate.

This shows an improvement over the prior art of mechanical dithering the entire RLG by drastically reducing the dithering inertia, increasing the dither frequency, decreasing the dither amplitude and increasing peak angular velocity.

The present invention therefore includes the use of state of the art RLG design with the addition of tilting mirrors. The tilting mirrors are capable of tilting the surface of the mirror. The mirrors are driven by the same drive signal to all mirrors therefore eliminating the need to precisely control the amplitude and phase.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an RLG with four tiltable mirrors.

FIG. **2** illustrates one possible configuration that will tilt the surface of a mirror.

FIG. **3** illustrates all four mirrors tilted by angle θ and the optical path rotated by θ'.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** shows a ring laser gyroscope **10** with frame **12**, cathode **14**, anodes **16** and four tiltable mirror assemblies **18**, **20**, **22**, **24**. Mirrors **18** and **20** have path length control devices **26**. Mirror **22** has prism **28** and heterodyne detector **30** with output signals **32**. Mirror **24** has detector support structure **34** for intensity detectors **36**. The signals **38** and path length control electronics **40** are used to control the path length control devices **26** to maintain a constant length of optical path **42**. The four tiltable mirror assemblies are controlled with a sinusoidal drive signal **44**.

FIG. **2** shows the tiltable mirror assembly **50** made up of a moated mirror **52**, support structure **54** and drive PZTs **56** and **58**. PZTs **56** and **58** are electrically wired such that a voltage on sinusoidal drive signal **70** causes the length of PZT **56** to increase while the length of PZT **58** decreases. This applies a force on center post **60**, resulting in a deformation of the thin moated webs **62** and a tilting of the mirror surface and optical coating **64**. When this mirror is mounted on frame **66**, the optical beam **68** is partially transmitted through the mirror coating **64** and passes through openings in the PZTs **56** and **58**.

FIG. **3** shows a geometric ray trace of the optical path **102** defined by the four mirrors **100**. When the four mirrors are tilted by angle θ to angular position **100'**, the optical path **102** rotates to optical path **102'**. The angle between optical path **102** and **102'** is θ' defined by

$$\theta'=\theta+\text{Arctan}\,(r*\sin(\theta)/(R-r*\cos(\theta)))$$

where r is the radial distance **104** from mirror **100** to the center of the gyro and R is the radius of curvature of mirror **100**.

It is not intended that this invention be limited to the hardware or operational procedures shown disclosed. This invention includes all of the alterations and variations thereto as encompassed within the scope of the claims as follows.

I claim:

1. A ring laser gyroscope with tilting mirrors comprising:

a frame;

cathode and anode means mounted on said frame for producing two counterpropagating waves traveling in opposite directions about an optical path within said frame;

four tiltable mirror assemblies mounted on said frame for defining said optical path;

path length control electronic means for maintaining a constant length of said optical path; and,

sinusoidal drive signal means connected to said four tiltable mirror assemblies for sinusoidally tilting said tiltable mirror assemblies to sinusoidally rotate said optical path.

2. A ring laser gyroscope with tilting mirrors as defined in claim **1** wherein a first of said four tiltable mirror assemblies comprises:

a mirror arrangement attached to said frame; and,

a first path length control device attached to said mirror arrangement.

3. A ring laser gyroscope with tilting mirrors as defined in claim **2** wherein a second of said four tiltable mirror assemblies comprises:

a mirror arrangement attached to said frame; and,

a second path length control device attached to said mirror arrangement.

4. A ring laser gyroscope with tilting mirrors as defined in claim **3** wherein a third of said four tiltable mirror assemblies comprises:

a mirror arrangement attached to said frame;

a prism attached to said mirror arrangement; and,